Science Flight Report
Operation IceBridge Antarctica 2010

Flight: **F07**
Mission: **LVIS86c**

Flight Report Summary

Aircraft	**DC-8 (N817NA)**
Flight Number	110112
Flight Request	118003
Date	Wednesday, November 10, 2010 (Z), Day of Year 314
Purpose of Flight	Operation IceBridge Mission LVIS86c
Take off time	12:02:42 Zulu from Punta Arenas (SCCI)
Landing time	00:26:42 Zulu at Punta Arenas (SCCI) on November 11, 2010 (Z)
Flight Hours	12.5
Aircraft Status	Airworthy.
Sensor Status	All installed sensors operational.
Significant Issues	None
Accomplishments	• High-altitude survey (>35,000 ft) of several hundred ICESat tracks along 86°S arch around South Pole from 240°E to 90°E. • Completed entire mission as planned. • ATM, MCoRDS, gravimeter, LVIS, POS/AV, and DMS were operated on the survey lines. ATM and MCoRDS were operated in an experimental mode only due to the high altitude mission. • Snow and Ku-band radars were operated in experimental mode only on this flight due to the high altitude mission. • Conducted a ramp pass at Punta Arenas airport for ATM, LVIS and DMS instrument calibration (12,000 ft AGL). • Conducted pitch and roll maneuvers for LVIS calibration over Bellingshausen Sea and Strait of Magellan.
Geographic Keywords	Antarctica, Scott-Amundsen South Pole Station, Transantarctic Mountains, Polar Plateau, East Antarctica
ICESat/CryoSat Track	Several hundred ICESat tracks
Repeat Mission	Partial reflight of November 4, 2010 transit route along 90°E to South Pole and transit back to Punta Arenas.

Science Data Report Summary

Instrument	Instrument Operational			Data Volume	Instrument Issues
	Survey Area	Entire Flight	High-alt. Transit		
ATM	☑	☒	☒	12 GB*	None
MCoRDS	☑	☒	☒	2 TB*	None
Snow Radar	☒	☒	☒	70 GB*	N/A
Ku-band Radar	☒	☒	☒	70 GB*	N/A
LVIS	☑	☒	☒	55 GB	Frost on window
DMS	☑	☒	☒	9.7 GB	None
POS/AV (510 + 610)	☑	☑	☑	2 GB	None
Gravimeter	☑	☑	☑	80 MB	None
DC-8 Onboard Data	☑	☑	☑	40 MB	None

*Note: ATM, MCoRDS, snow and Ku-band radar are operating in experimental mode only on high altitude flights. Theses instrument teams are not required to submit data to NSIDC from today's flight unless they are satisfied with the quality of their data product.

Mission Report (Michael Studinger, Mission Scientist)

The weather forecast predicted no-go conditions for all our high and medium priority targets, as well as the reserve missions (Fig. 1). The only mission plan we considered during the weather brief this morning was the Crosson 01 mission. A very short 3 hour weather window with slightly worse than marginal conditions and significant topography in the survey area seemed too much of a risk for this mission.

We decided to draft an alternative mission plan that would avoid the widespread bad weather along the entire Antarctic Peninsula and most of Marie Byrd Land. The South Pole area was the only target site in reach with good conditions. The AMPS model predicted some scattered clouds over the Transantarctic Mountains which was in agreement with the latest MODIS image we got before takeoff.

The airport tug was not in operation this morning and the aircraft was still parked in the fueling position. Thanks to the skilled crew we were able to get out of the tight parking position by using only the left engines, making sure we don't damage the small building next to the ramp.

Today's mission is a completion of the 86°S arc around South Pole that we have begun last year on October 25, 2009 and continued this year on November 4, 2010. The clouds are predicted in the least important part of the survey line over the Transantarctic Mountains, where the steep topography may violate the assumptions for the analysis of the ICESat orbits. The goal is to allow intercomparison of LVIS and ICESat altimetry over hundreds of ICESat orbits, where they are concentrated along an arch at 86°S, the inflection point of the ICESat orbits. Coincident LVIS and ICESat footprint elevation differences will be derived as a function of ICESat campaign in order to investigate the magnitude of the ICESat intercampaign biases.

Before the beginning of the arch the window of the LVIS laser began again building up frost on the outside similar to the flight on November 4, 2010 (Fig.2). The frost built up started around the same time after takeoff on both flights. The post-flight analysis on November 4, 2010 indicated that the nadir 5 window obstruction ended up being caused by jet fuel contamination. The source of the fuel contamination was believed to be fuel that had collected in the left hand wheel well area and then streamed aft to the nadir 5 window. The fuel in the wheel well area is minor seepage from the left hand forward auxiliary fuel tank. This occurs only when the aircraft is fueled up to approximately 160,000 lbs

for the long flights and then the aircraft sits for any substantial time. For the flight on November 4 the aircraft was fueled on October 30, 2010 and then flights were cancelled each day until we ended up flying on November 4, 2010. In order to prevent the window from being obscured again we implemented several changes in procedures. After each mission the aircraft is fueled less the forward aux tanks and then on the morning of flight we fuel the forward aux tanks. In addition to this we keep the LVIS shutter closed until we reach altitude and are exposed to temperatures below the freezing point of jet fuel. The source area was cleaned after the November 4 flight and we have not had any issues during the last two flights. On today's flight we discovered that another nadir port that is not in use on this campaign was also obscured by frozen jet fuel. Unlike the nadir 5 glass window for LVIS this window is an acrylic window and the shutter was closed at all times. We closed the shutter of the LVIS window and this reduced the frost a bit.

The jet fuel frost deteriorated the performance of the LVIS laser by roughly one order of magnitude, but due to a large performance margin the LVIS instrument was able to get surface returns along the cloud free segments of the arc and with better quality than on the November 4, 2010 flight.

The new high power ATM laser was operating in experimental mode and got surface returns from up to 33,000 ft AGL and was recording data along the entire arch on its second flight. The MCoRDS radar system was operating in experimental mode as well and was getting bed returns over large portions of the arch filling a long-standing data gap in ice thickness around the South Pole area. The snow radar and Ku-band radars were experimenting today as well and getting very promising surface returns from 30,000 ft.

After we completed the arch at 90°E we did an overpass of the Amundsen-Scott South Pole Station, in order to best utilize the high-rate GPS data being collected there for our trajectory computations. We switched of all laser and radar science instruments 30 nautical miles before South Pole in order to avoid interference with any science experiments that are going on in the so called "dark sector" around South Pole Station. We flew over South Pole at 18:29 UTC and switched on the radars and lasers again after clearing the dark sector 26 nautical miles behind South Pole.

Individual instrument reports from experimenters on board the aircraft:

ATM: The new high altitude ATM system worked well and collected good data on its second flight.

MCoRDS: The MCoRDS radar collected data over land ice. Good bed returns along large portions of the arch.

Snow and Ku-band radar: Experimental operation with very promising surface returns.

Gravimeter: Worked well. No issues.

DMS: DMS worked well and collected about 1600 frames.

LVIS: The LVIS system worked well. A frost layer on the outside of the window impacted the performance of the system by an order of magnitude, but LVIS acquired range data over the entire cloud free portion of the arch.

POS/AV: Systems worked well. No issues.

DC-8 on board data: System worked well. The aircraft position caused an interruption in position data while flying over South Pole.

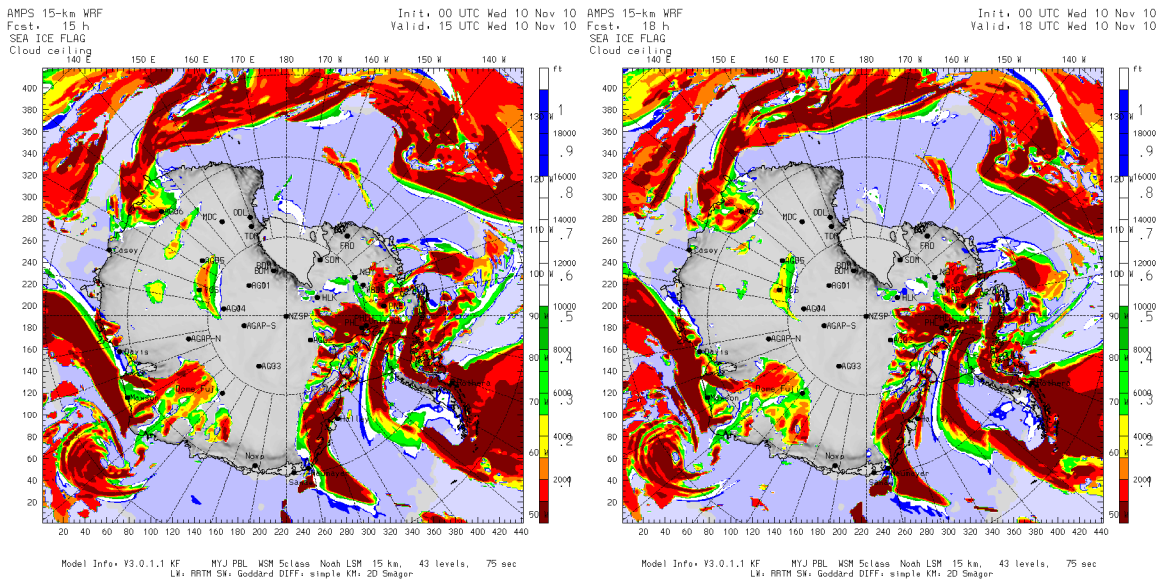

Figure 1: AMPS model forecast available before takeoff.

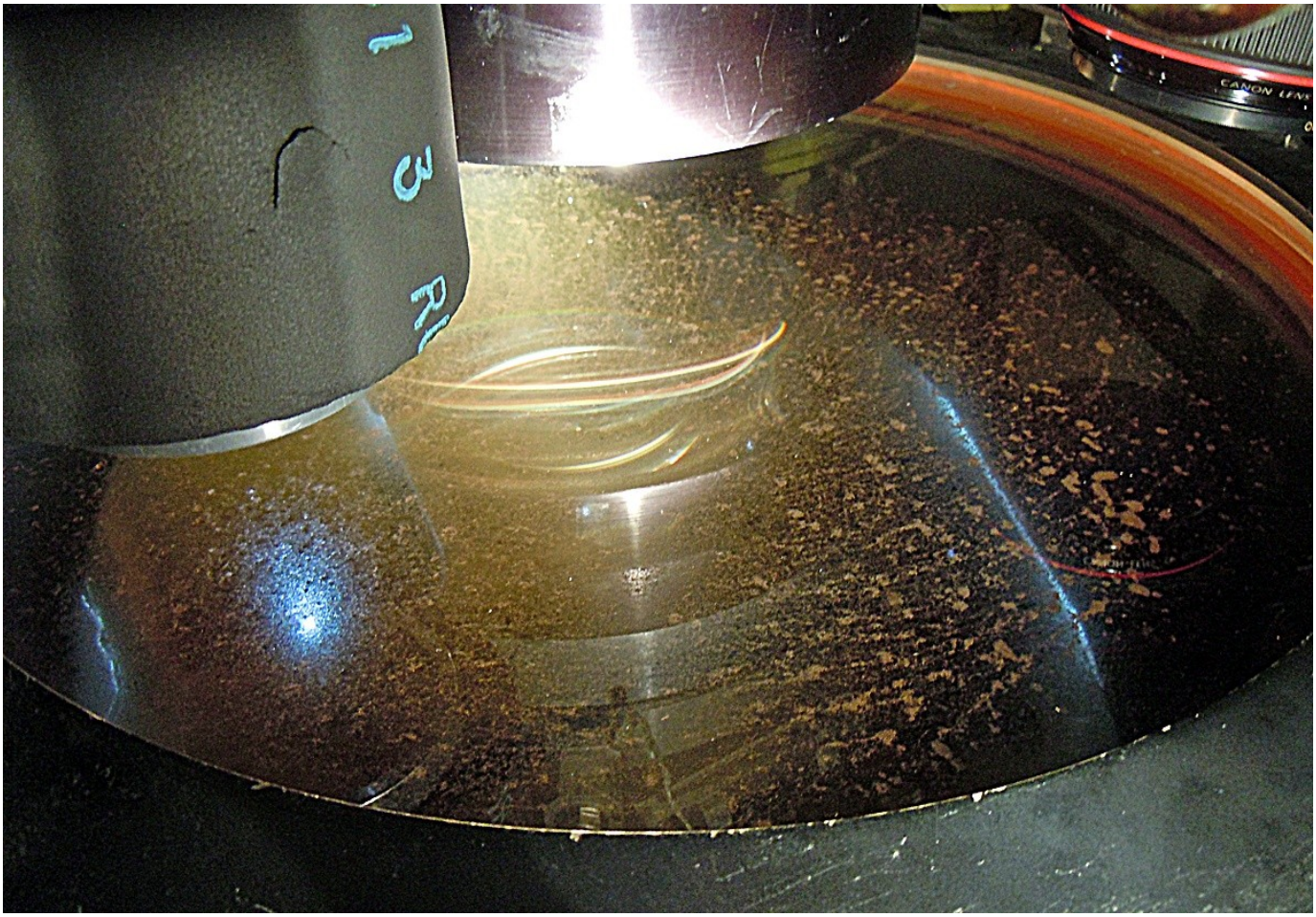

Figure 2: Frost from fuel contamination on the outside of LVIS nadir 5 window (with shutter closed) during today's mission before we reached the survey line. Photo: M. Studinger

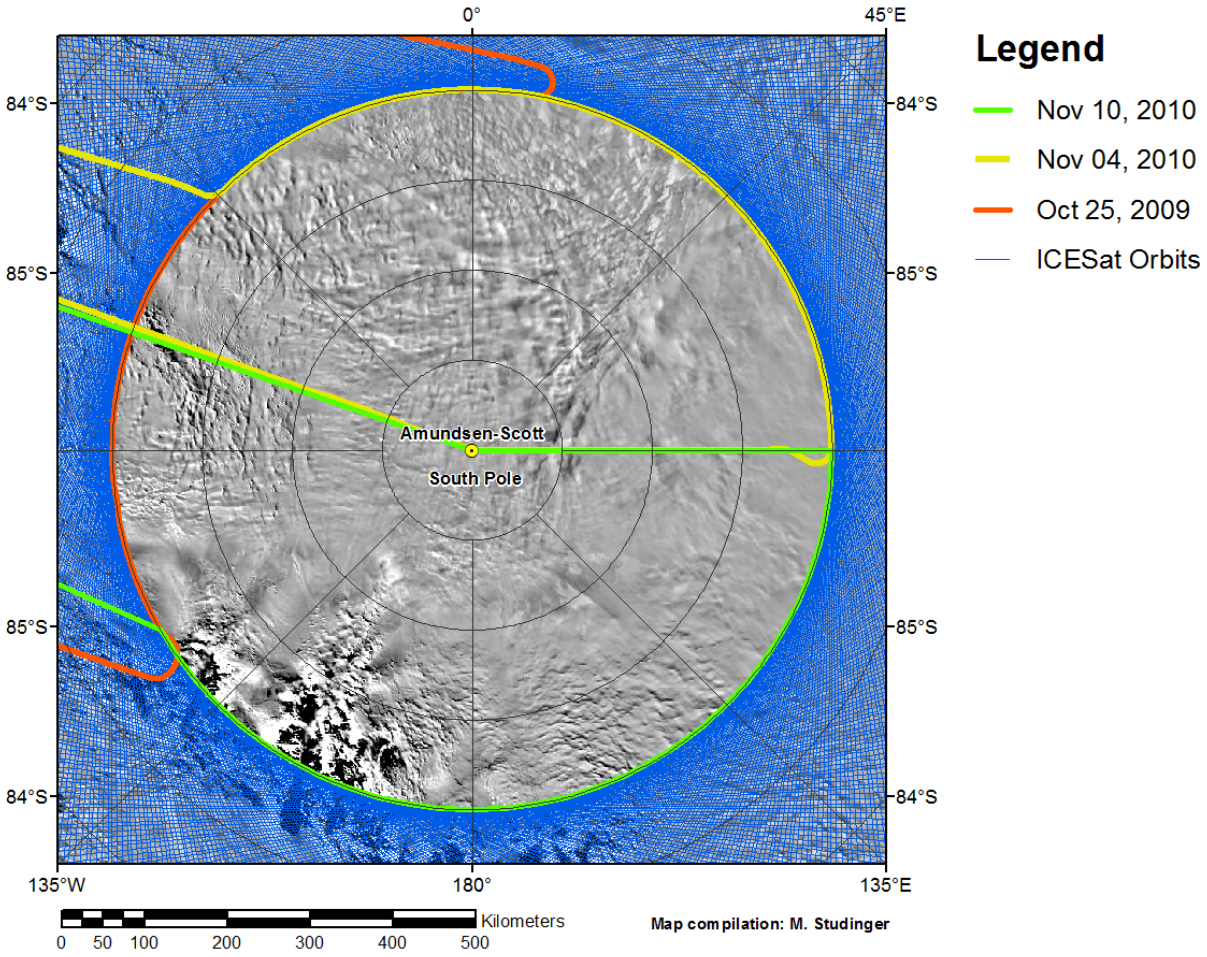

Figure 3: Map with complete 86°S arc around South Pole.

Figure 4: Amundsen-Scott South Pole Station as seen by the Digital Mapping System camera (DMS) on today's flight.